

# Physiology of Ovarian & Endometrial Cycle



*GUYTON & HALL, Chapter 81*

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# Objectives

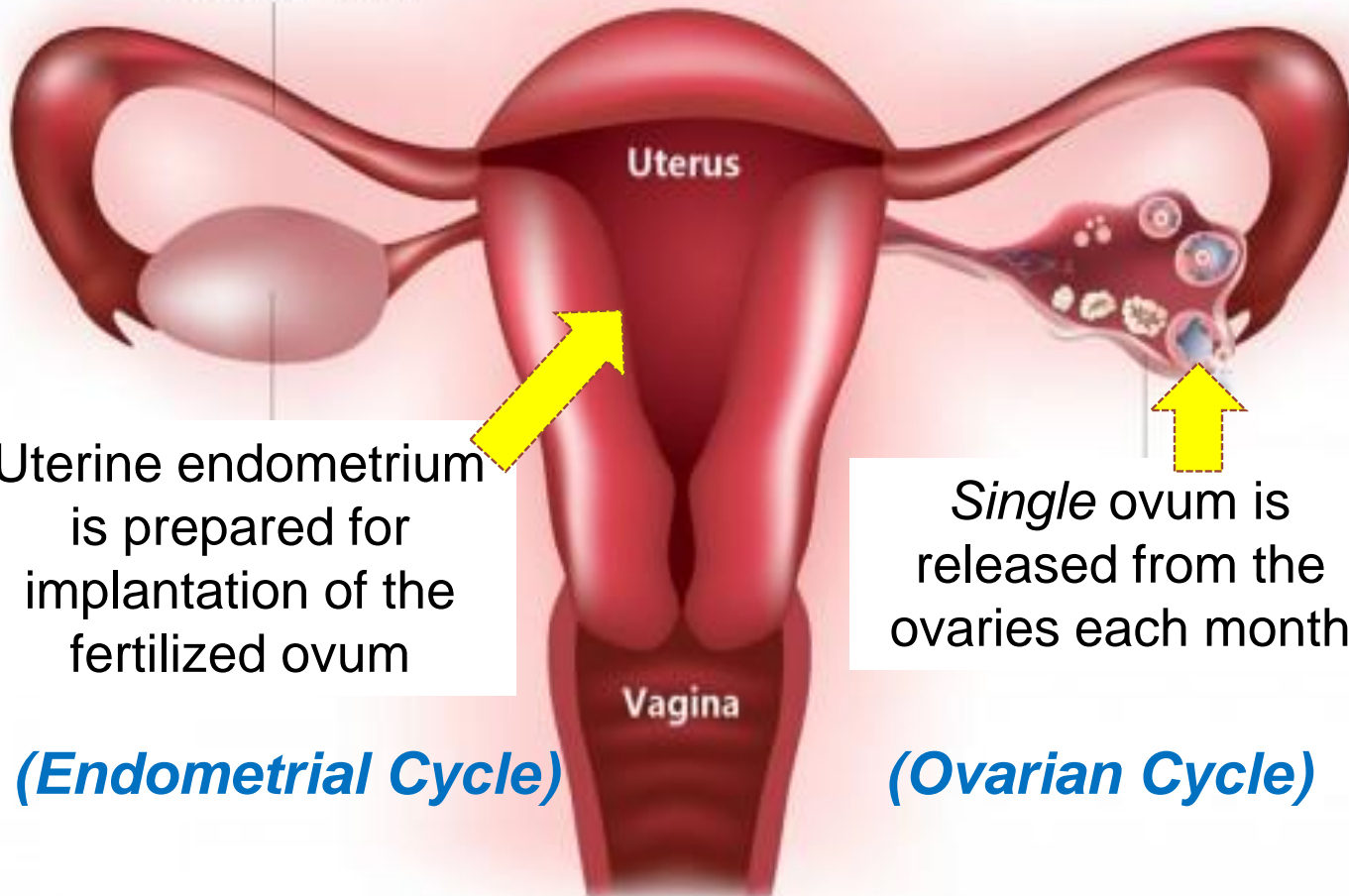


## By the end of this lecture, you should be able to:

1. Recognize the hypothalamic-*pituitary-ovarian* (HPO) axis
2. Describe the physiological phases of ovarian and endometrial cycles
3. Describe the structural changes that occur in the ovaries and endometrium during menstrual cycle and explain how these changes are hormonally regulated
4. Describe the development and the fate of corpus luteum
5. List the female hormones and describe their physiological functions
6. Describe the physiology of menopause and the disorders of menstruation

# Sexual (Menstrual) Cycle

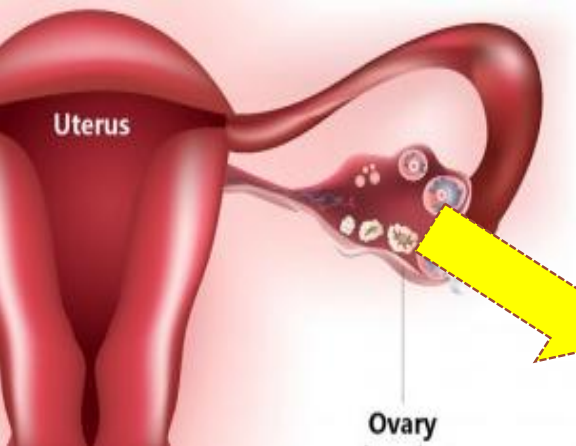
Fallopian Tube



## Ovary functions:

- 1- Oogenesis.
- 2- Secretion of estrogens and progesterone.

Duration of the cycle averages **28 days** (20-45 days)



# Ovarian Cycle

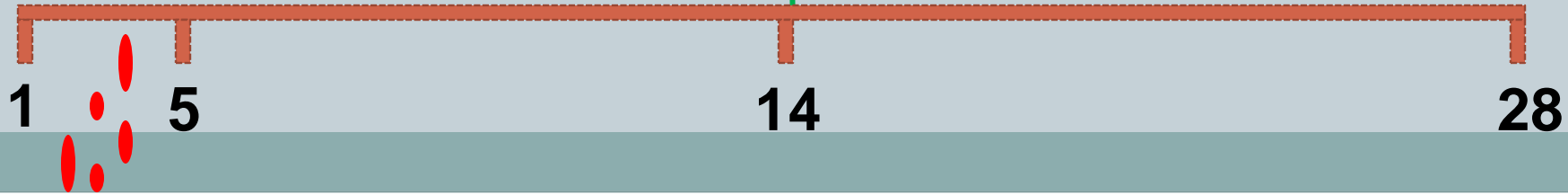
Follicular  
Phase  
(Preovulatory)

(Dominated by estradiol)

Ovulation

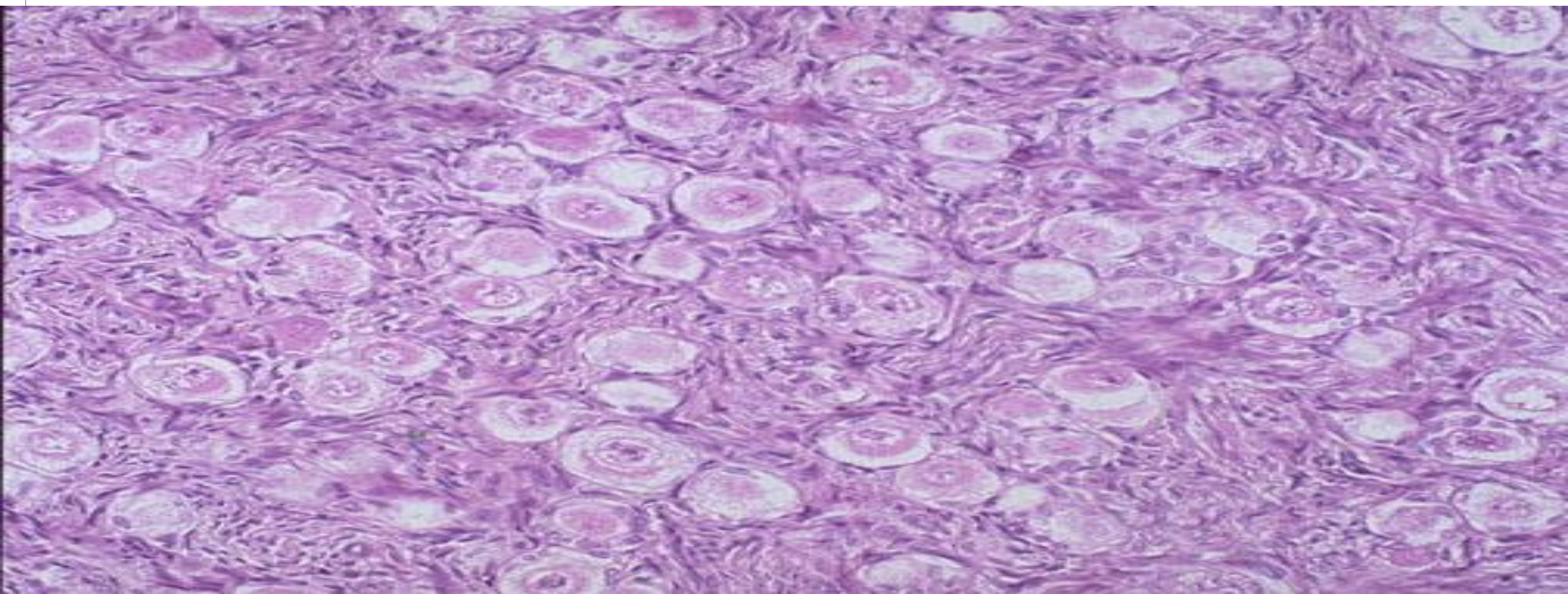
Luteal  
Phase  
(Postovulatory)

(Dominated by progesterone)



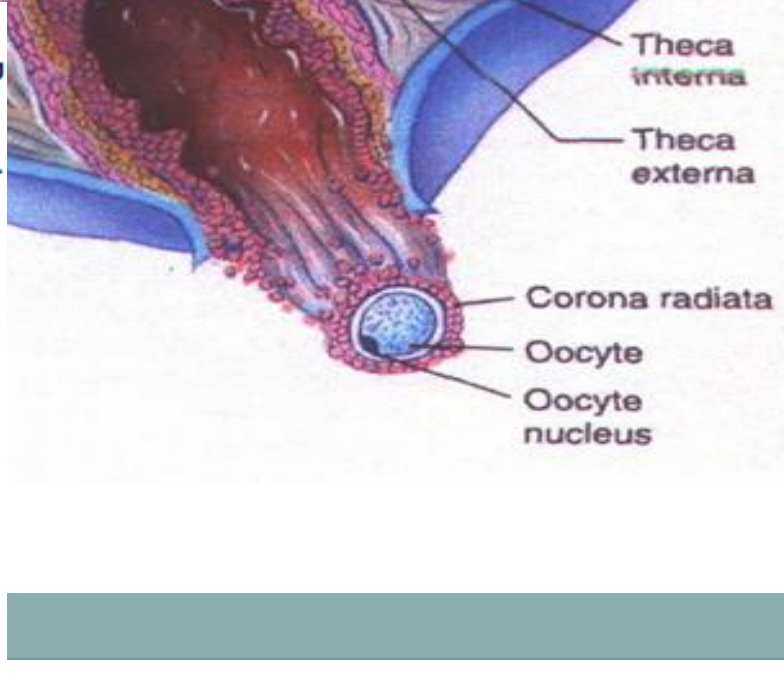
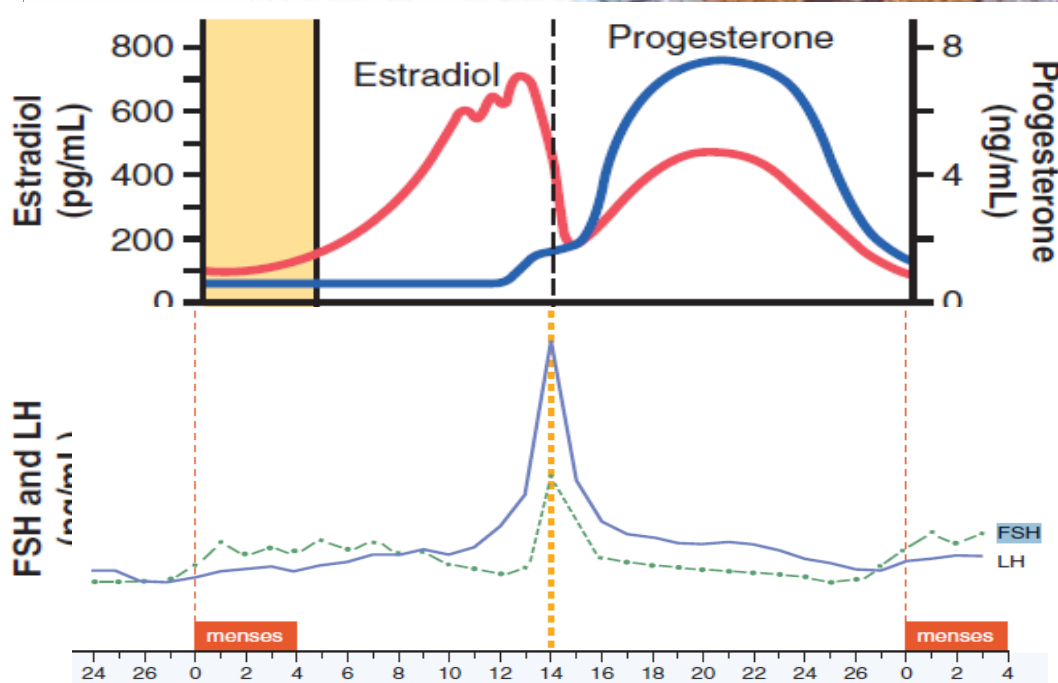
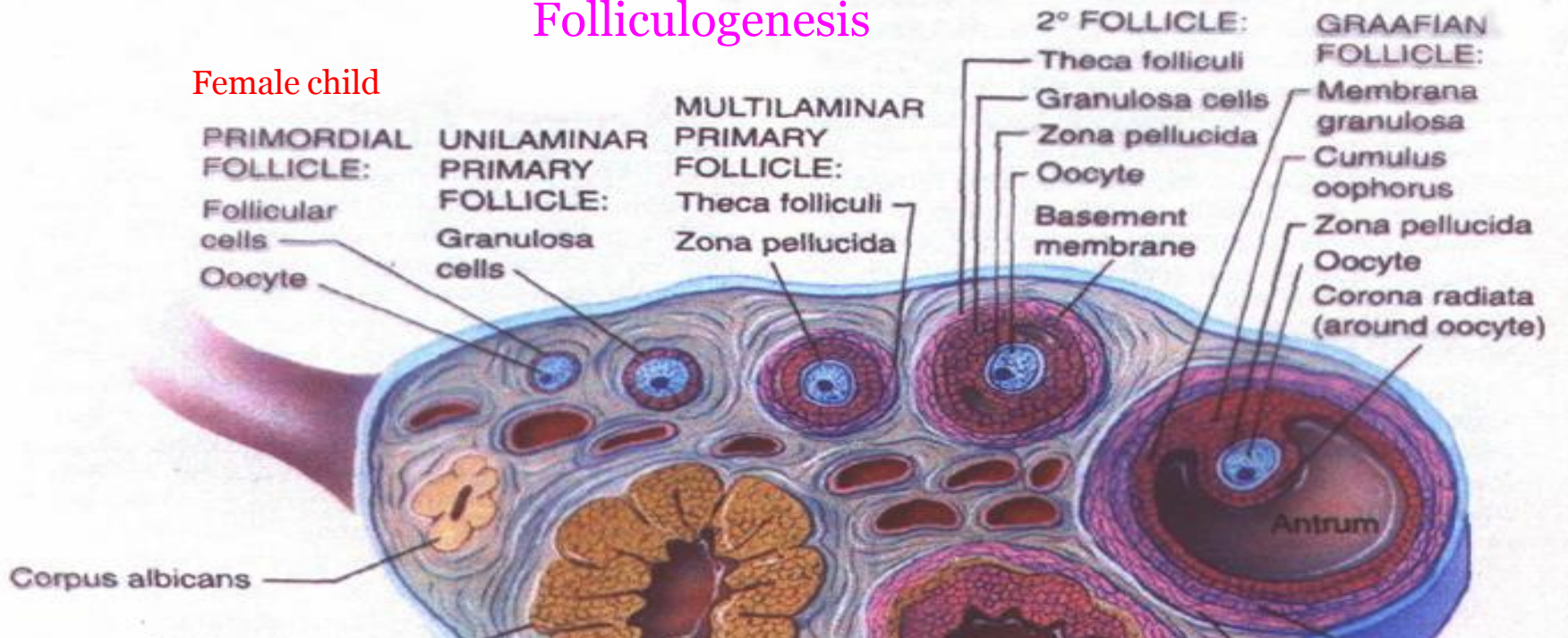
# Ovarian Cycle

- **By 16-20 weeks gestation:** 6-7 million oogonia.
- **At birth:** 1-2 million oocytes.
- **At puberty:** 300,000 to 500,000 oocytes.
- 400-500 oocytes will normally ovulate during women's entire reproductive life.



# Folliculogenesis

Female child

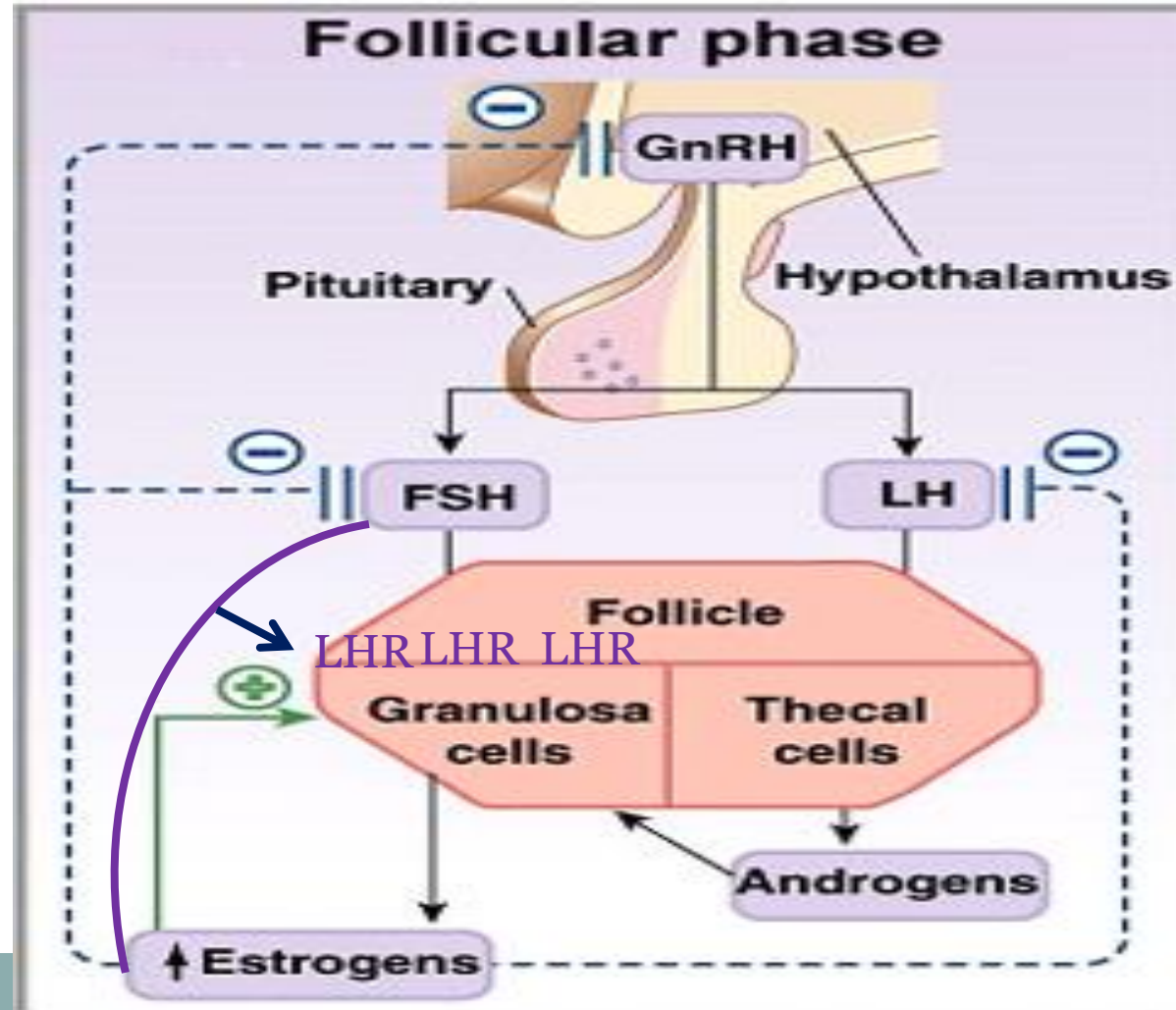


The early growth of the primary follicle up to the **antral stage** is under **FSH** stimulation only. Then there is **accelerated growth** of the follicle to larger follicle called **vesicular follicle (Graffian)** caused by:

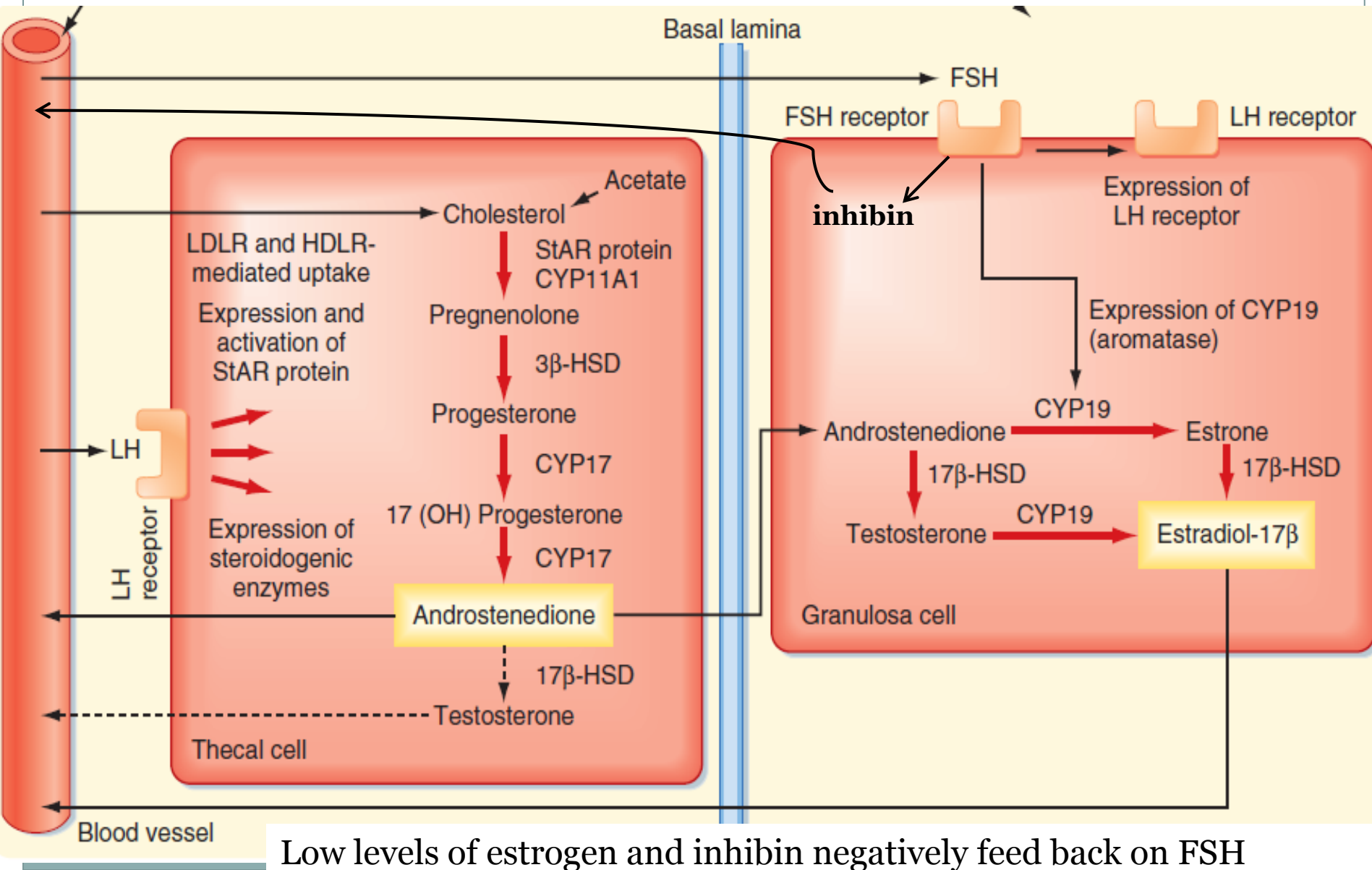
1. Estrogen  $\uparrow$  FSH receptors (**positive feedback effect**).
2. Estrogen & FSH combine to promote **LH** receptors on the **original granulosa cells** in addition to FSH stimulation.



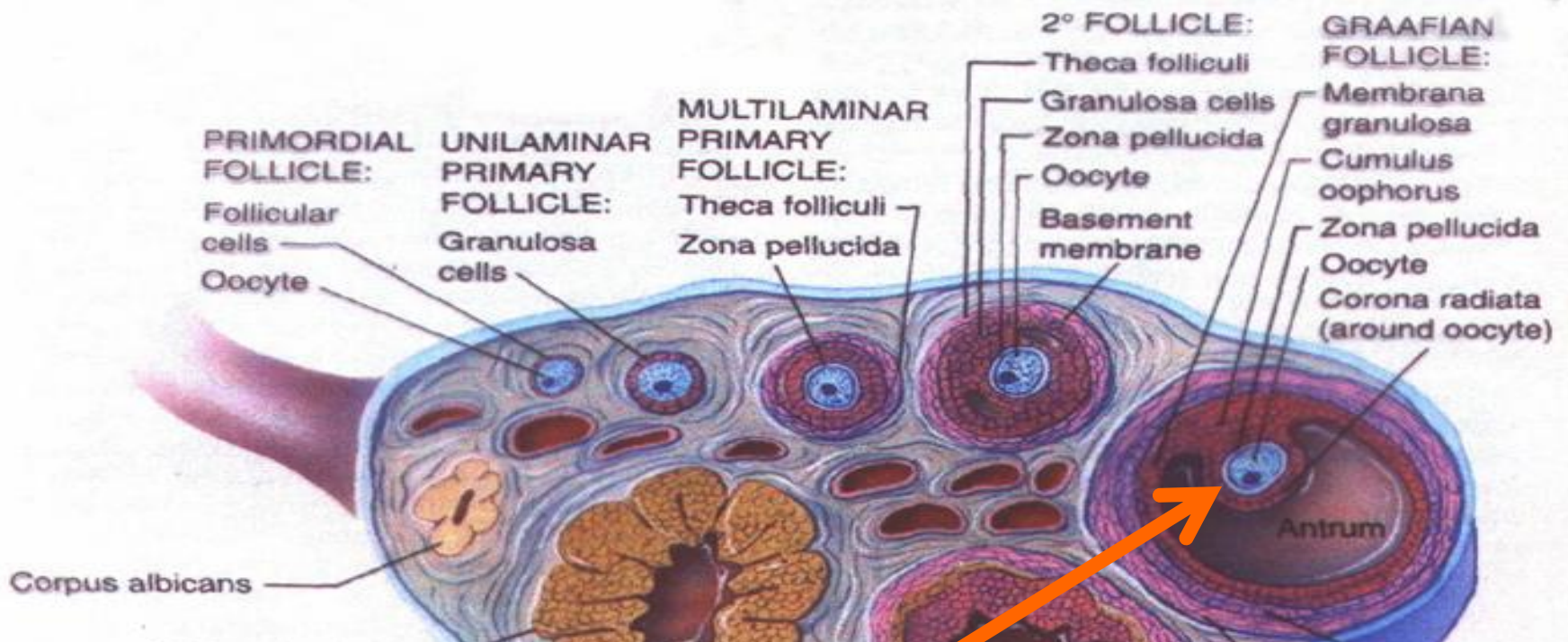
Proliferation of the follicular cells & increase their secretion.



# Follicular Phase







- The **antral follicles** begin to grow. The ovum enlarges & remains embedded at one pole of the **granulosa cells** of the follicle
- After a week or more of growth—but before ovulation occurs—one of the follicles begins to outgrow all the others, and the remaining 5 to 11 developing follicles **involute** (a process called **atresia**)

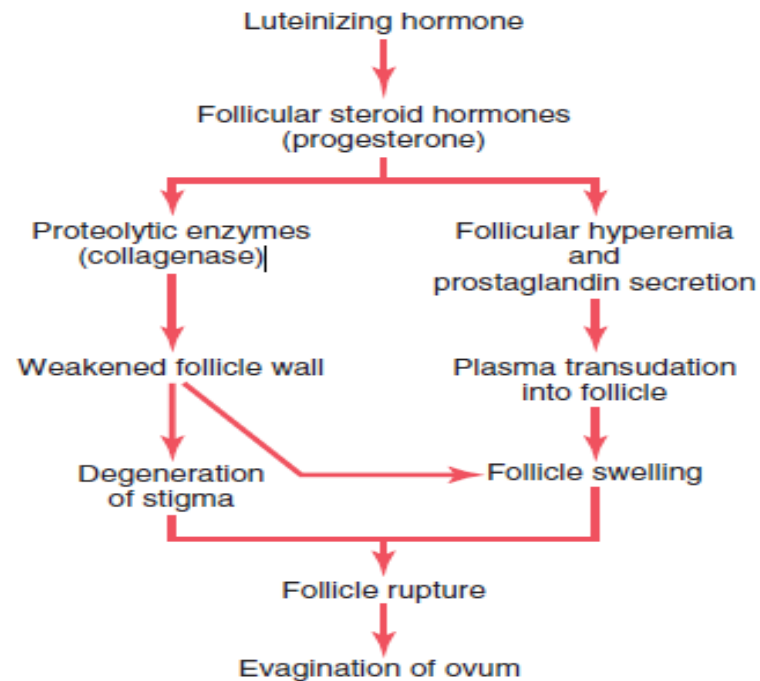
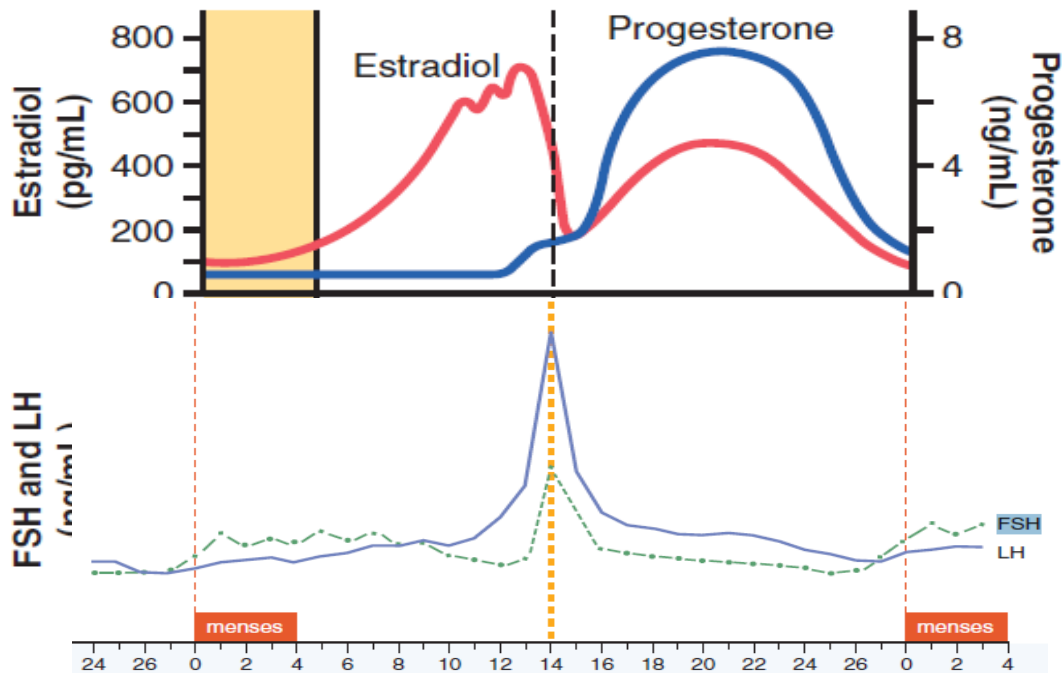
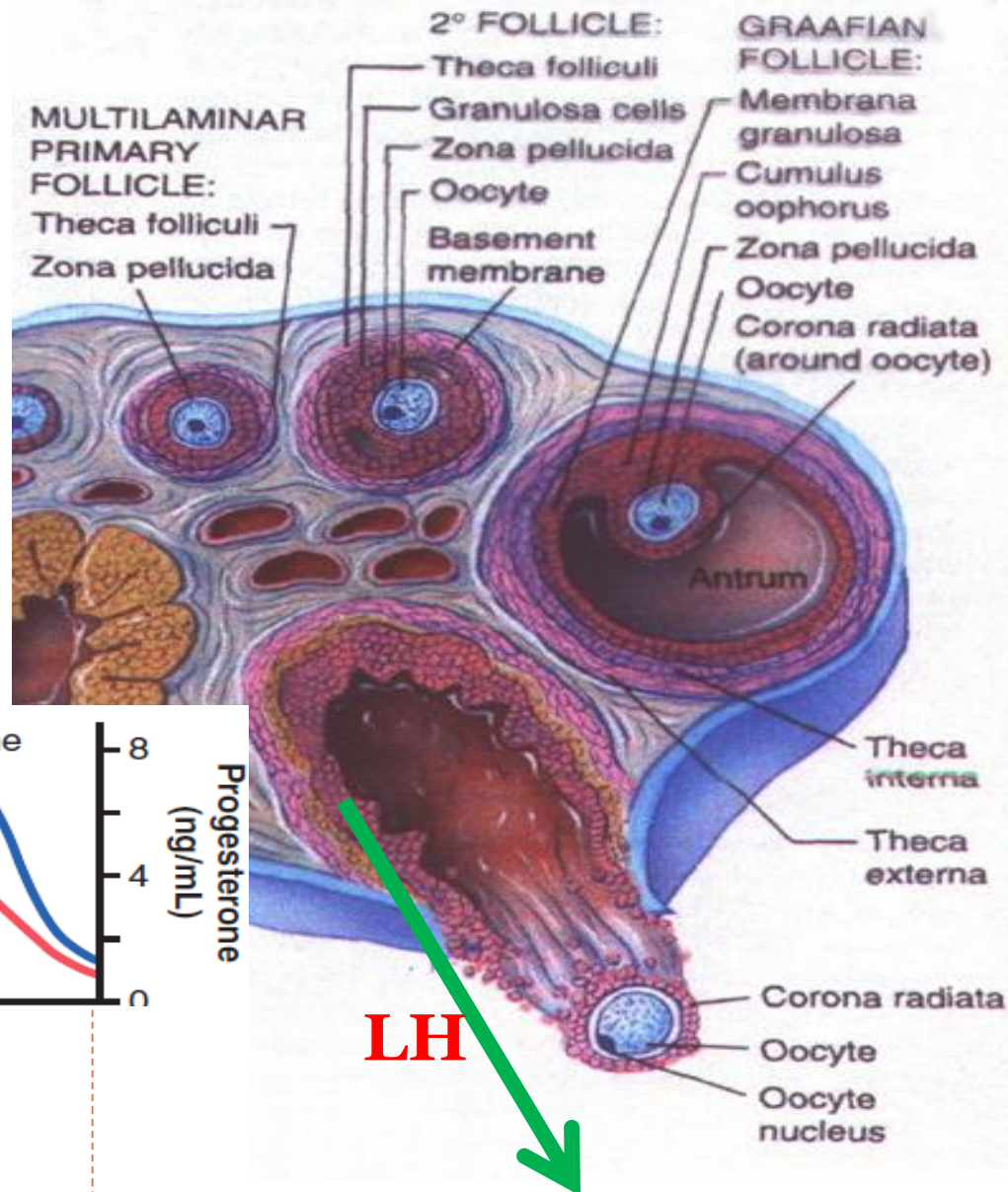


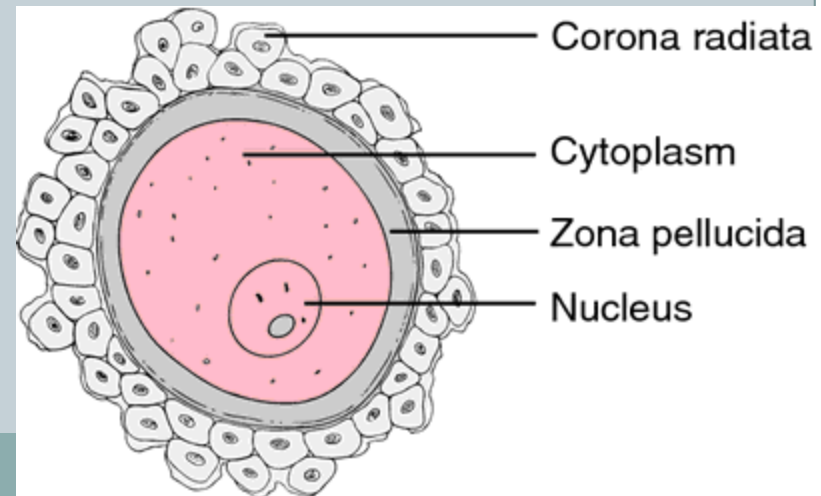
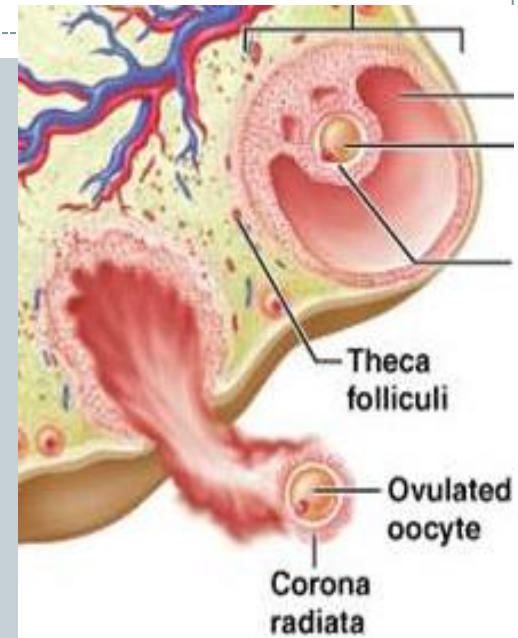
Figure 82-6. The postulated mechanism of ovulation.



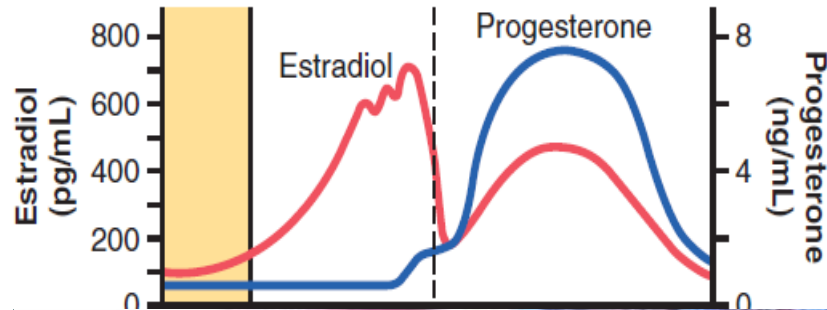
**progesterone-secreting cells**

# Ovulation

During ovulation, stigma protrudes & fluids ooze from the follicle & the stigma ruptures allowing more viscous fluid outward carrying with it the ovum surrounded by mass of granulosa cells called corona radiata



# Corpus Luteum



**MULTILAMINAR PRIMARY FOLLICLE:**  
 Theca folliculi  
 Zona pellucida

**2° FOLLICLE:**  
 Theca folliculi  
 Granulosa cells  
 Zona pellucida  
 Oocyte  
 Basement membrane

**GRAAFIAN FOLLICLE:**  
 Membrana granulosa  
 Cumulus oophorus  
 Zona pellucida  
 Oocyte  
 Corona radiata (around oocyte)

Corpus albicans

Corpus luteum {  
 Theca lutein  
 Granulosa lutein

Antrum

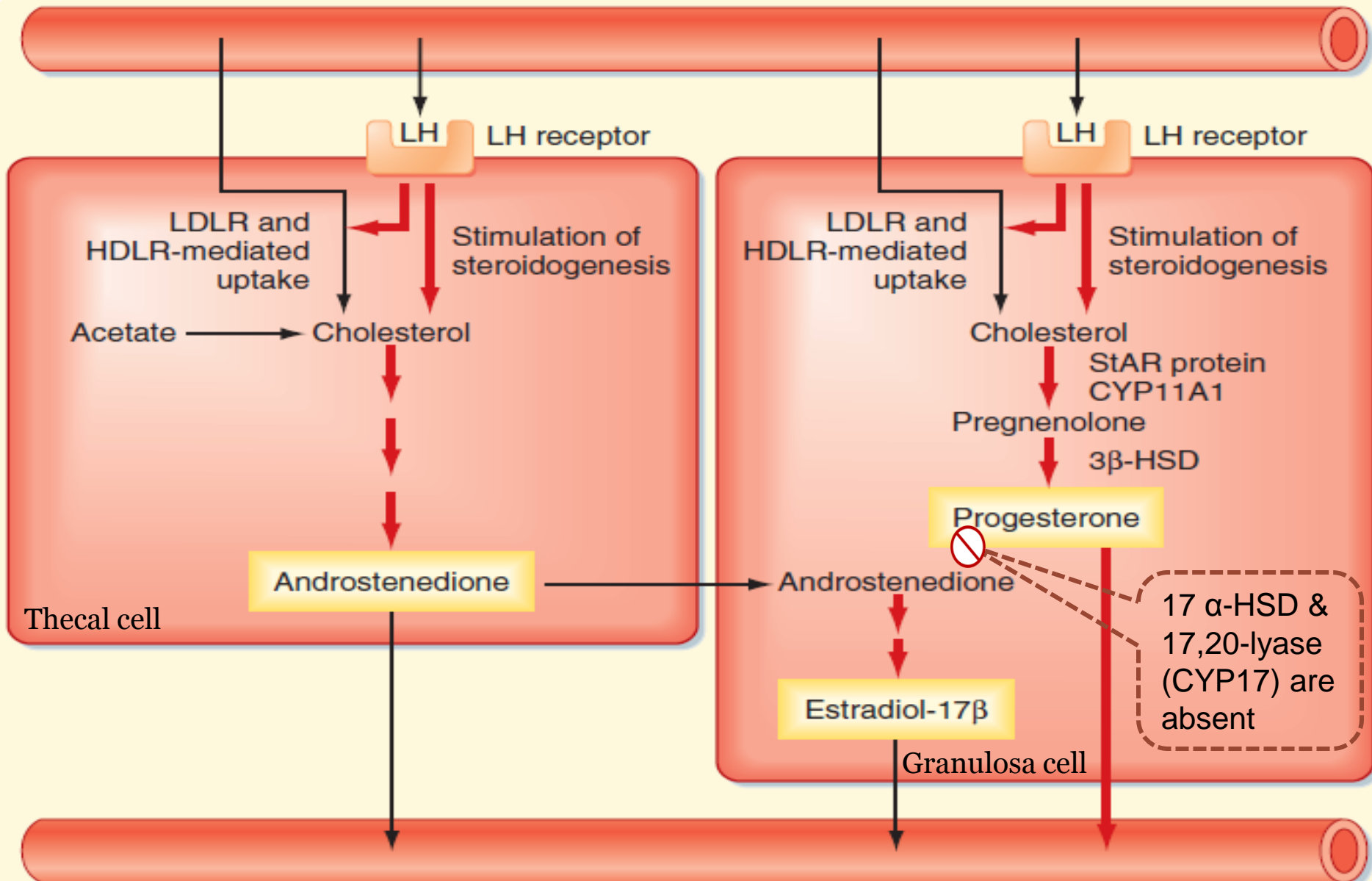
Theca interna  
 Theca externa

Corona radiata  
 Oocyte  
 Oocyte nucleus



# Luteal Phase

Vascularization of the *corpus luteum* makes low LDL available to the granulosa-lutein cells



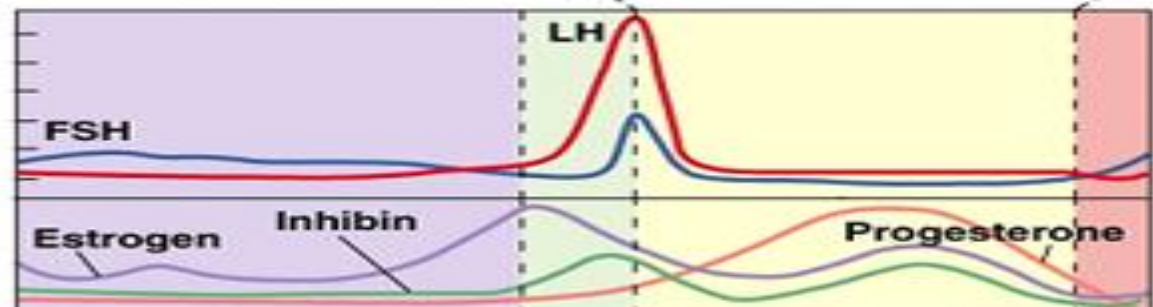
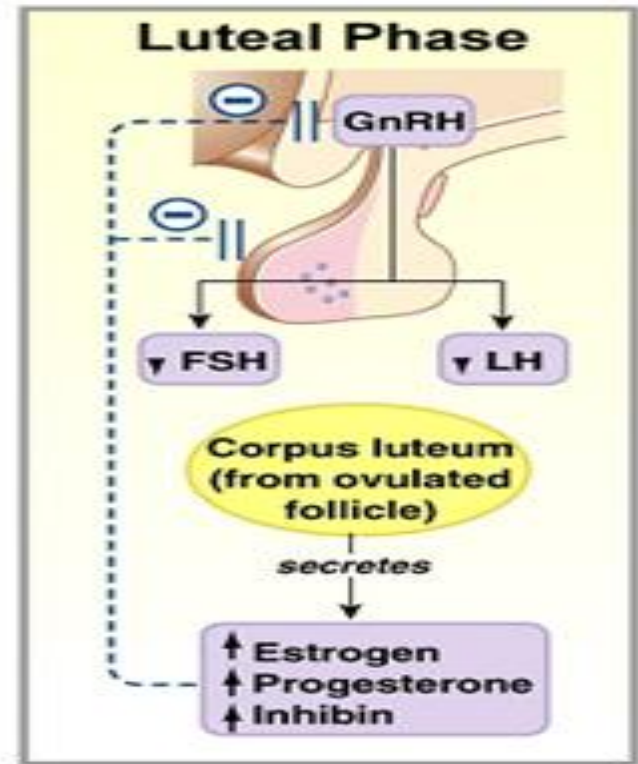
# Corpus Luteum



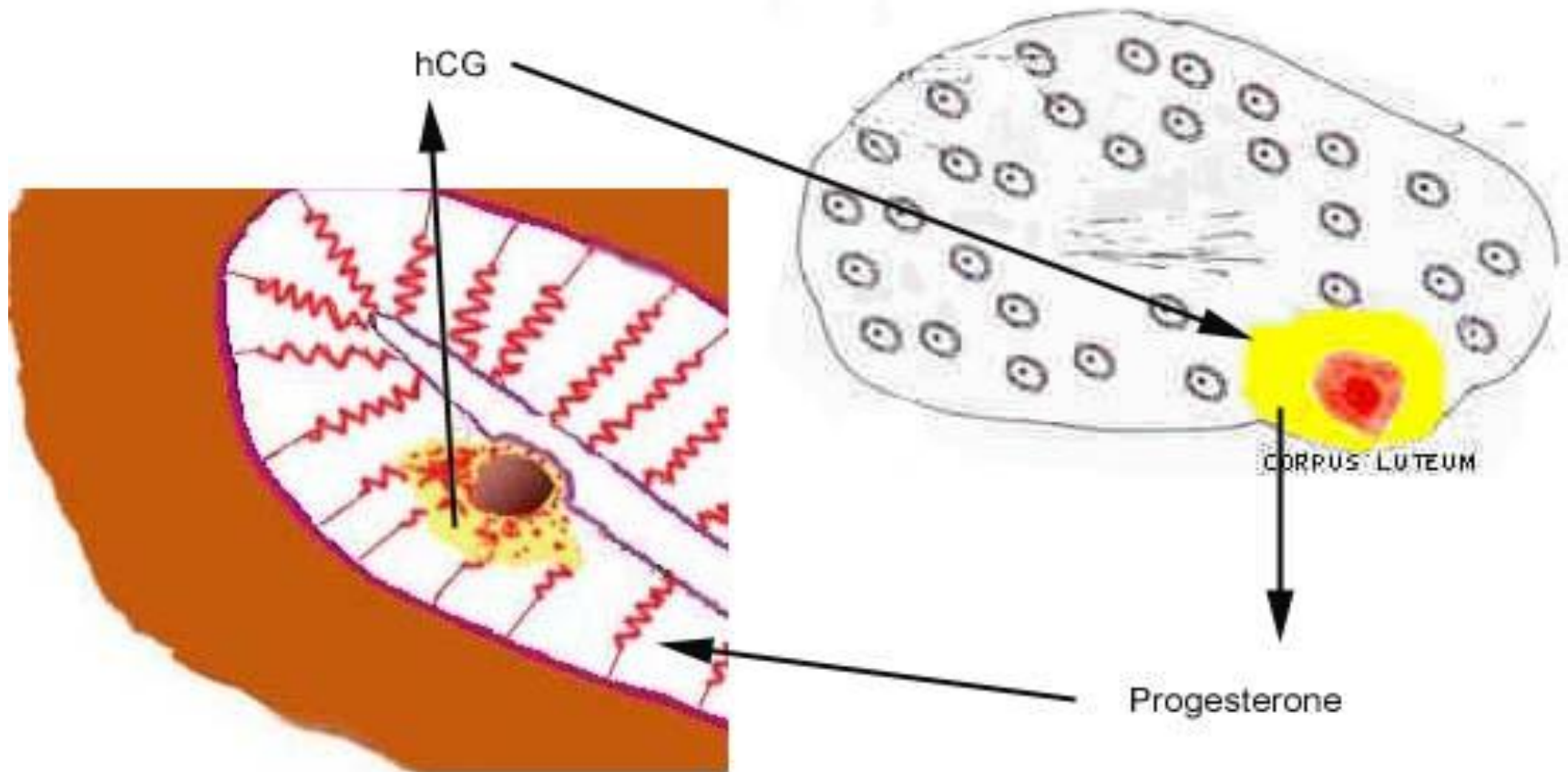
## Function of LH:

- 1- Causes ***ovulation***.
- 2 -Causes ***luteinization*** (changes the granulosa and theca cells into lutein cells.
- 3 - Maintains secretion of progesterone & estrogen from the corpus luteum.

# Involution of the corpus luteum and onset of the next ovarian cycle

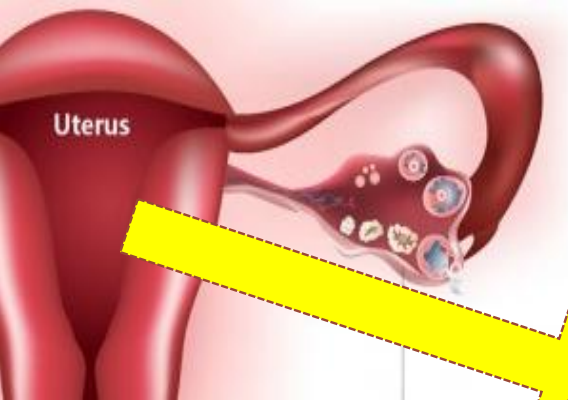


# Rescue of Corpus Luteum



- If pregnancy occurs, the hCG from the Trophoblast acts on the corpus luteum to prolong its life for 2 to 4 months of pregnancy





# Uterine Cycle

Proliferative  
phase  
(Preovulatory)

(Dominated by estradiol)

Secretory  
phase  
(Postovulatory)

(Dominated by progesterone)

Ovulation

1

5

14

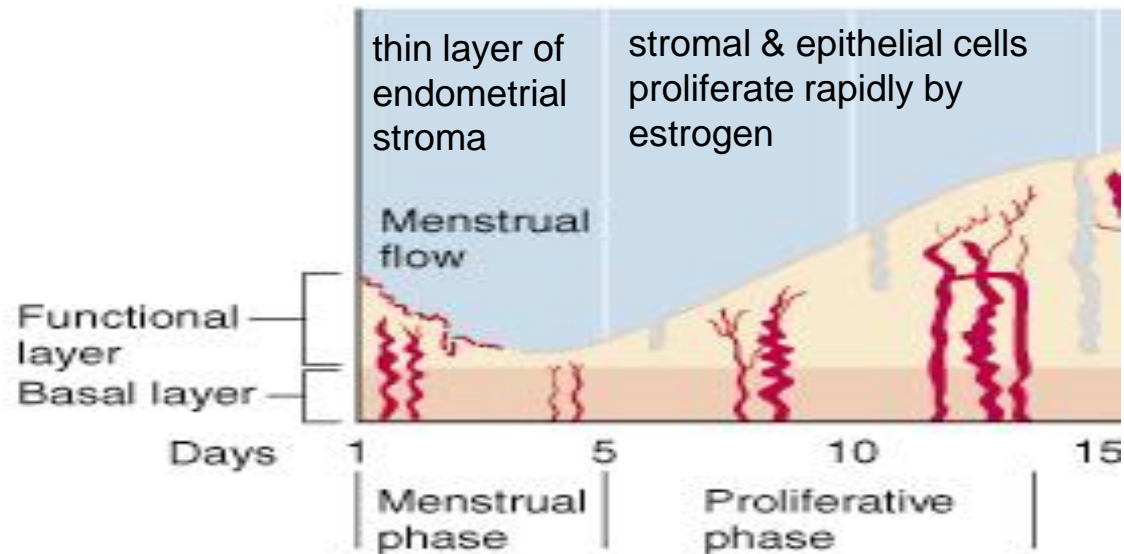
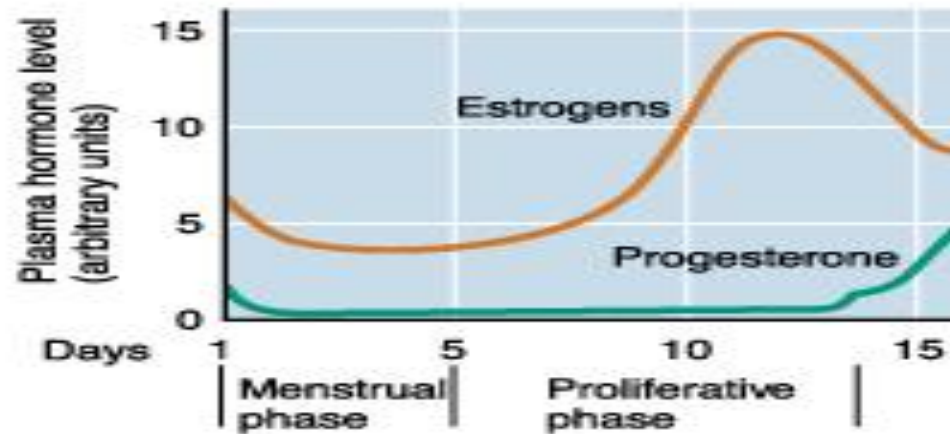
28



# Proliferative phase (estrogen phase)

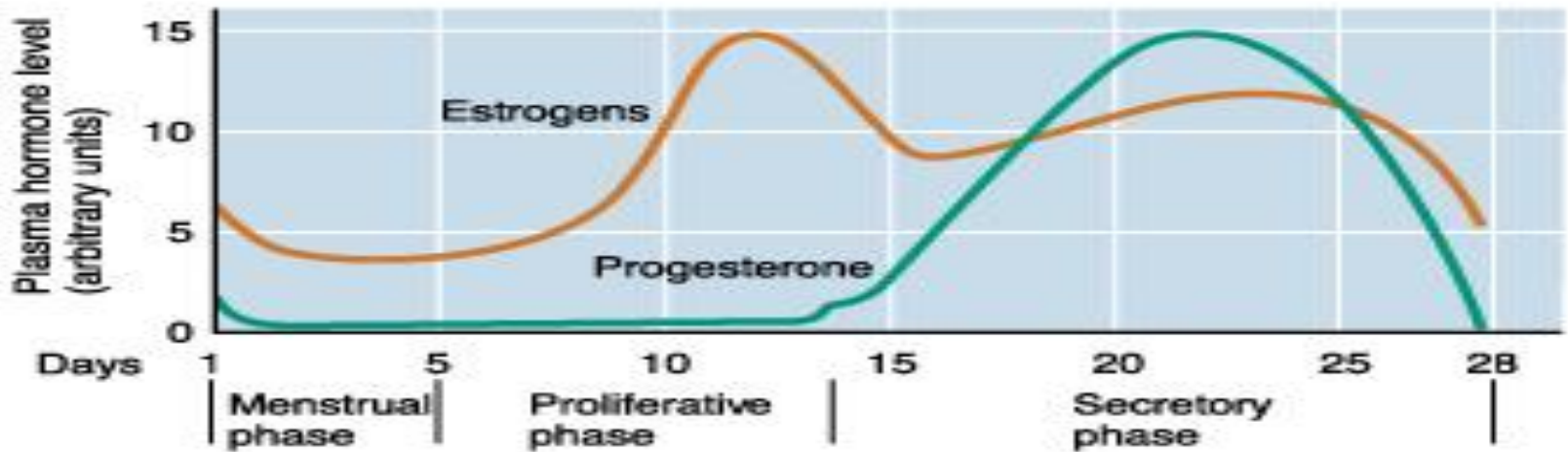
The endometrial surface re-epithelialized within 4-7 days after the beginning of menstruation. The endometrium thickness increases, due to increase numbers of stromal cells & progressive growth of the glands & new blood vessels.

At the time of ovulation, the endometrium is **3-5 mm thick**. The endometrial glands and cervical region secrete a thin, stringy mucus which helps to guide sperm in the proper direction from the vagina into the uterus.

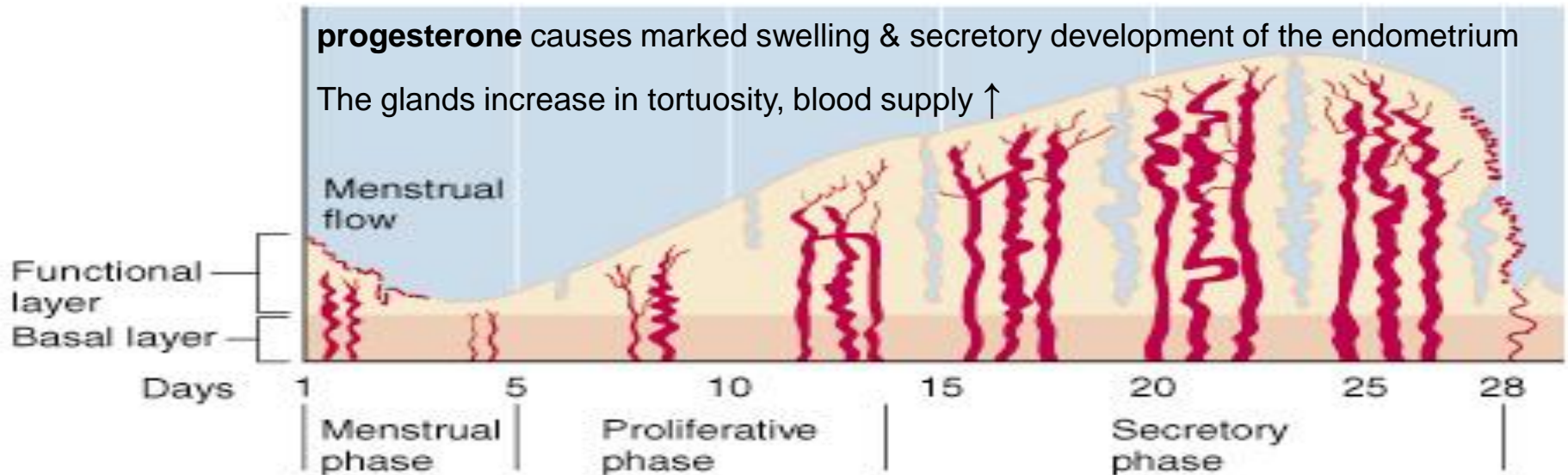


(d) Uterine cycle

# Secretory phase (progestational phase)



**progesterone** causes marked swelling & secretory development of the endometrium  
The glands increase in tortuosity, blood supply ↑



Stromal cells cytoplasm increase lipid & glycogen deposits, 1 week after ovulation, endometrium thickness is 5-6 mm . Uterine secretions called “**uterine milk**” provide nutrition for the dividing ovum.

# Menstruation



- -If the ovum is not fertilized, about 2 days before the end of the monthly cycle, the corpus luteum in the ovary suddenly involutes and the ovarian hormones (estrogens and progesterone) decrease to low levels of secretion,

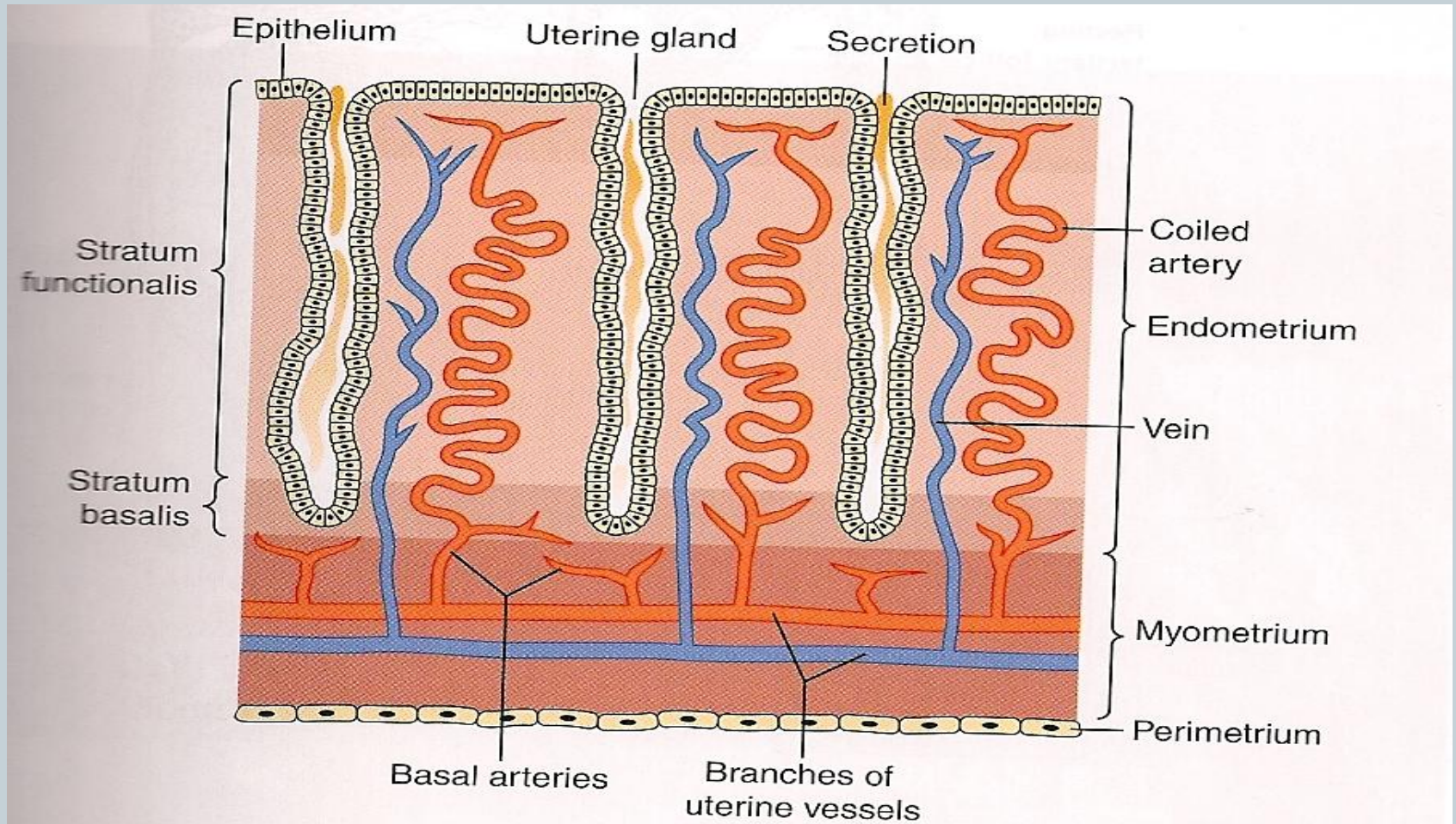
- **Necrosis is initiated in the endometrial blood vessels, due to:**

- 1) vasospasm
- 2) decrease nutrients to the endometrium
- 3) loss of the hormonal stimulation

- The mass of desquamated tissue & blood plus the contractile effects of prostaglandins all initiate contractions which expel the uterine contents.



# Uterine (endometrial) Cycle



# Menstruation



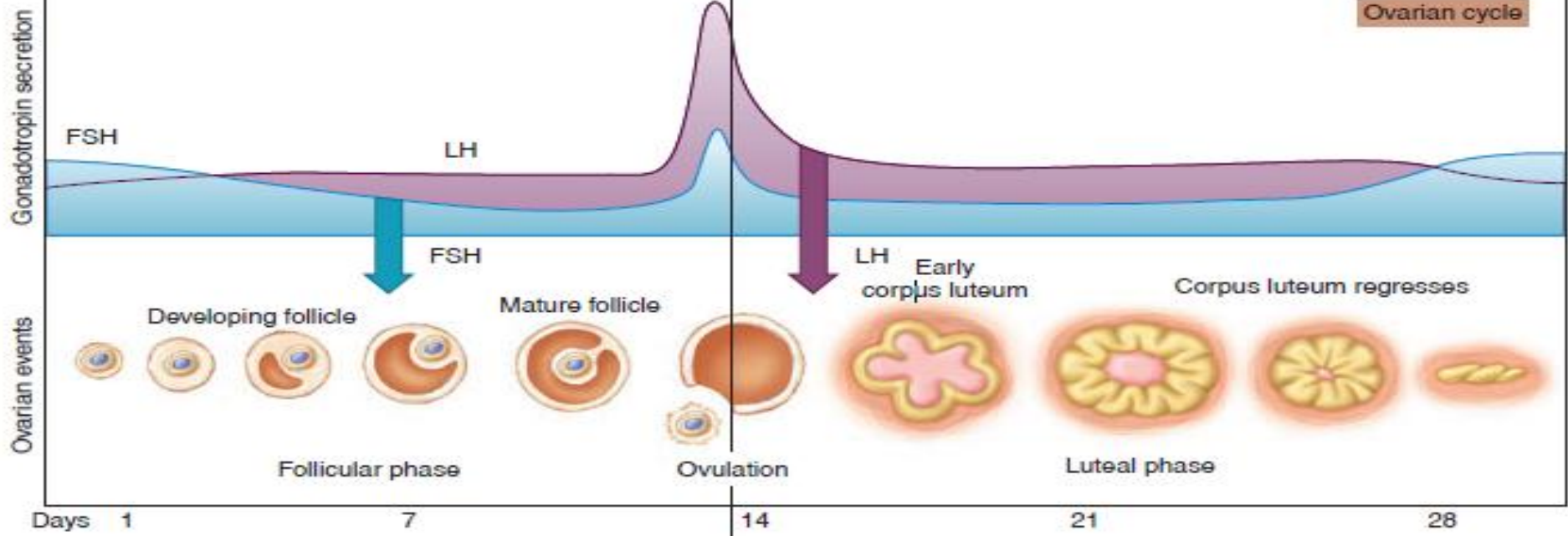
- **In normal menstruation**, about 40 ml of blood + 35 ml of serous fluid are lost. The menstrual blood is normally non-clotting due to the presence of fibrinolysin.

-Within 4 to 7 days after menstruation, the loss of blood ceases & the endometrium become re-epithelialized.

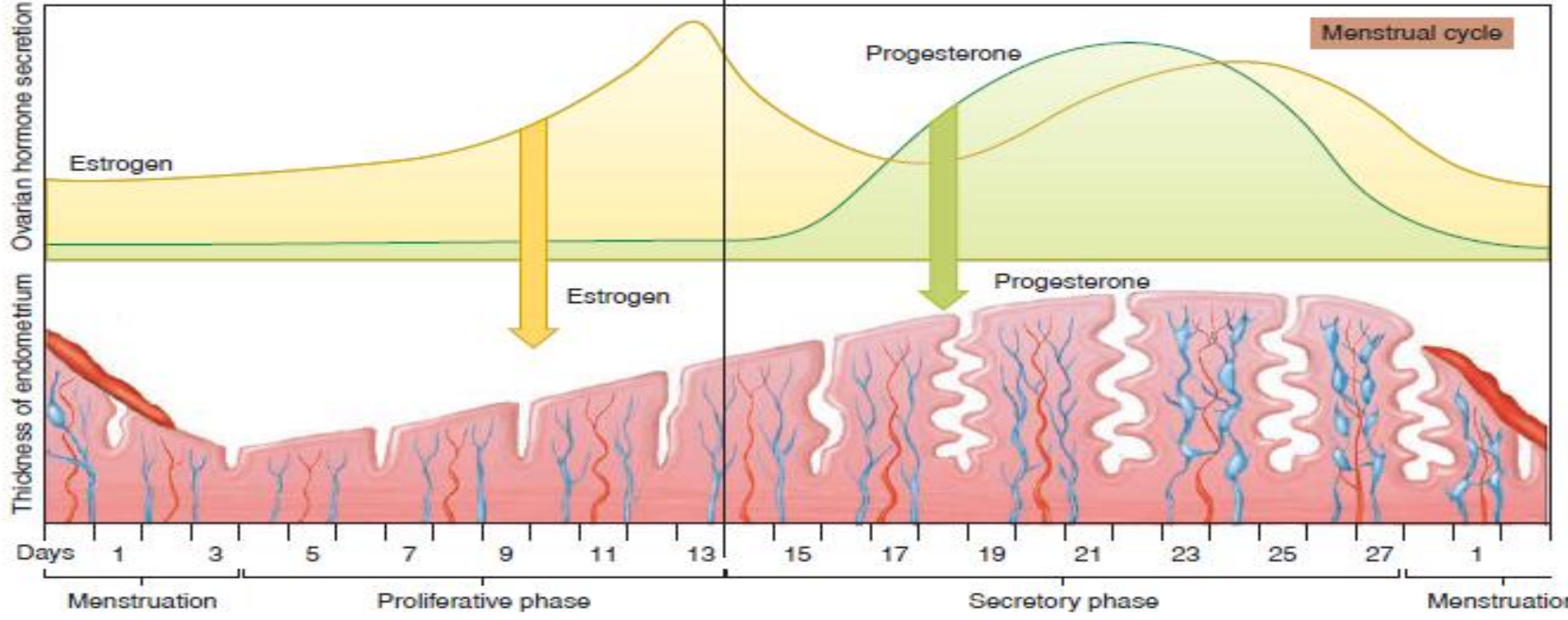
## Leukorrhoea during menstruation:

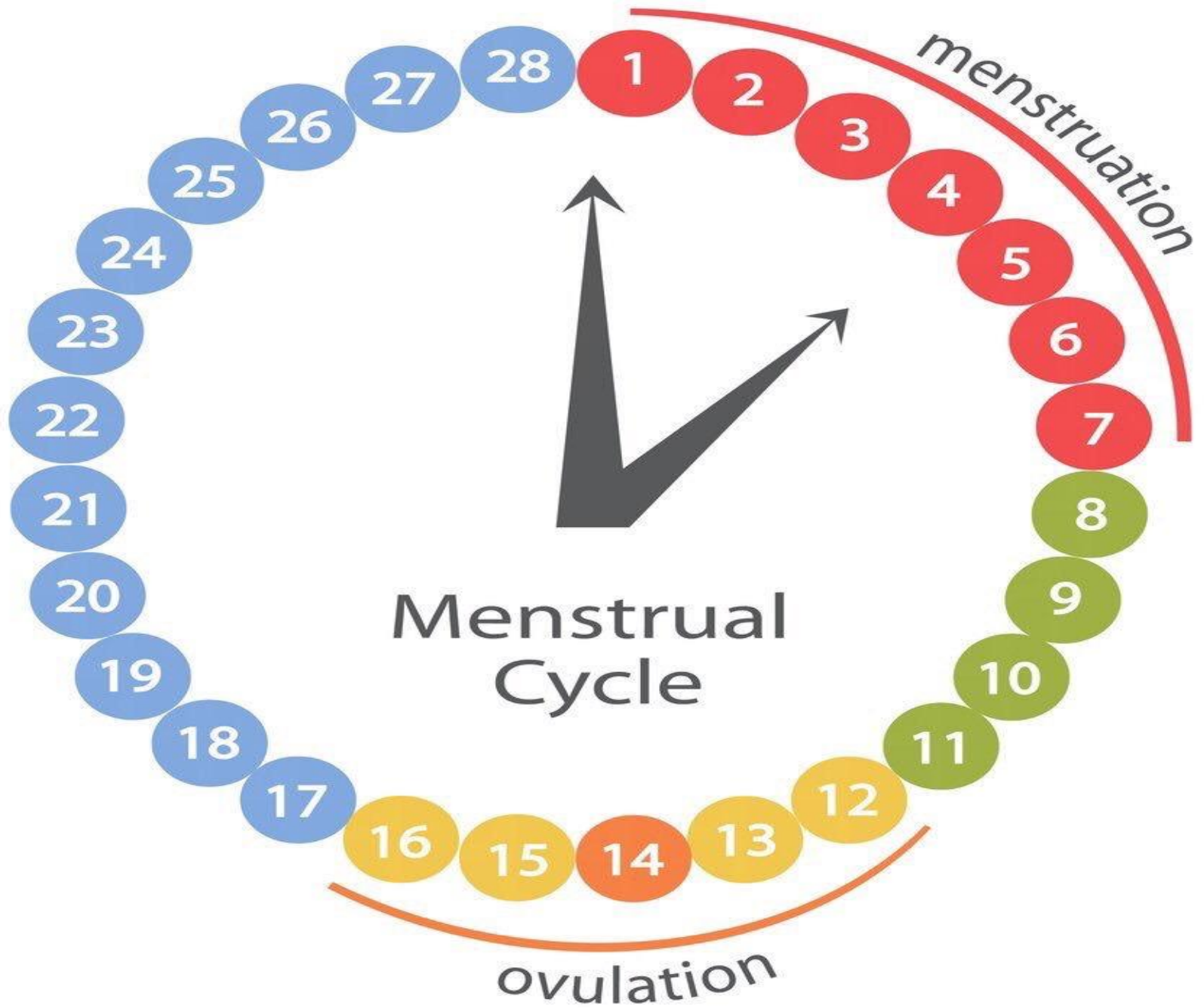
During menstruation, leukocytes are released with the necrotic material & blood so the uterus is highly resistant to infection during menstruation as protective mechanism.

Ovarian cycle



Menstrual cycle







# Functions of Estrogens



- Estrogens increase the size of ovaries, fallopian tubes, uterus, and external genitalia.
- Estrogens cause marked proliferation of the endometrial stroma and greatly increased development of the endometrial glands.
- Estrogens cause (1) development of the stromal tissues of the breasts, (2) growth of an extensive ductile system, and (3) deposition of fat in the breasts.
- Estrogens stimulate bone growth and slightly increase protein deposition.
- Estrogens increase body metabolism and fat deposition.
- Estrogens cause sodium and water retention by the kidney tubules.

# Functions of progesterone



- Progesterone promotes the secretory changes in the uterine endometrium.
- Progesterone promotes increased secretion by the mucosal lining of the fallopian tubes.
- Progesterone promotes development of the lobules and alveoli of the breasts, causing the alveolar cells to proliferate, enlarge, and become secretory.
- Progesterone decreases the frequency and intensity of uterine contractions.

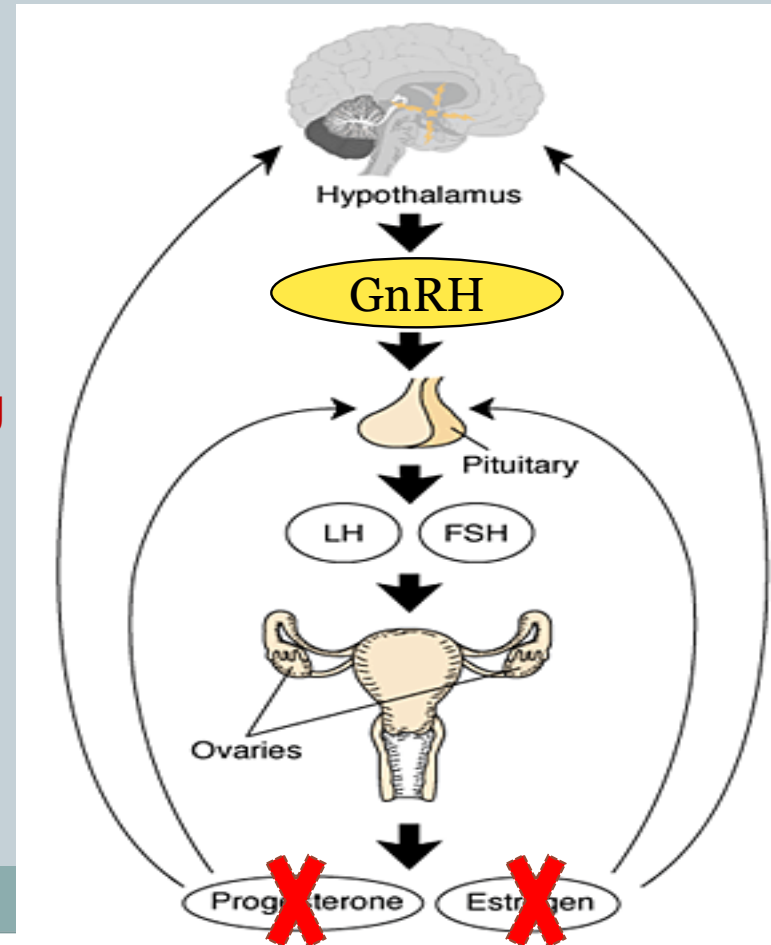
# Menopause and the Disorders of Menstruation

# Menopause

At the age of 45 to 51 years, the sexual cycle becomes irregular, ovulation fails to occur & the cycle ceases

The loss of estrogens causes marked physiological changes in the function of the body including:

“hot flushes” characterized by extreme flushing of the skin, psychic sensations and dyspnea, Irritability, fatigue, anxiety, occasionally various psychotic states, decreased strength and calcification of bones throughout the body.



# Disorders of Menstruation



**Amenorrhea:** Is absence of menstrual period either

- Primary amenorrhea in which menstrual bleeding has never occurred.
- Secondary amenorrhea cessation of cycles in a woman with previously normal periods, caused by:
  - Pregnancy (is the most common cause)
  - Emotional stimuli and changes in the environment.
  - Hypothalamic or pituitary diseases ( $\downarrow$  GnRH, FSH, LH pulses)
  - Hypothyroidism (TRH stimulates prolactin which  $\downarrow$  GnRH)
  - Primary ovarian disorders and various systemic disease.

**Menorrhagia:** Refer to abnormally heavy or prolonged bleeding.

**Hypomenorrhea:** Refer to scanty flow.

**Oligomenorrhea:** Refer to infrequent menstrual periods.

**Dysmenorrhea:** Painful menstruation (cramps due to accumulation of prostaglandins in the uterus).

**The End**

**Thank You**